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PATIENT AND ORGANISATIONAL PERSPECTIVES OF INITIAL TRAUMA CARE

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PATIENT AND ORGANISATIONAL PERSPECTIVES OF INITIAL TRAUMA CARE

THESIS FOR LICENCIATE DEGREE

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To my immensely loved family, Arthur, Vilde, Vincent and Victor

"Om personen du talar med inte tycks lyssna, var tålmodig,

det kan helt enkelt vara så att hen har lite ludd i ena örat".

Nalle Puh (A.A. Milne)

ABSTRACT

Physical trauma is one of the major causes of death and disability worldwide. In Sweden a similar pattern can be seen despite having a well-organised health-care system. Improvements in trauma care can increase survival for patients. Triage needs to be efficient and direct patients to adequate level of care. Patients' experiences of received care in the acute setting are rarely reported and needs to be investigated to increase patient satisfaction.

The aim of this thesis was to investigate patient and organisational perspectives of initial trauma care.

Study I was a quasi-experimental, implementation study, evaluating a criteria-directed protocol for triage of trauma patients. The results showed that by using the protocol, over triage rate was reduced from 74% to 52%. However, under triage increased from 7 % to 10%. After a meticulous review of the medical charts of the under triaged patients, no preventable deaths in this group was detected.

In study II, individual interviews were held with16 trauma patients regarding their experiences about the initial trauma care in the trauma room. The interviews were transcribed and analysed by using content analysis. The result was presented as one main category: "feeling safe in a frightening situation" and three generic categories: "emotional response", "physical discomfort" and "feeling prioritised or being ignored".

To summarise, findings from the two studies showed that there is room for improvements in in-hospital triage as well as in the psycho-social treatment of trauma patients at the trauma centre.

Keywords: *emergency care, injury, over triage, under triage, trauma team, patient experience, interview, content analysis*

LIST OF SCIENTIFIC PAPERS

I. **A criteria-directed protocol for in-hospital triage of trauma patients**
Granström A, Strömmer L, Schandl A, Östlund A
European Journal of Emergency Medicine 2018;25(1):25-31

II. **Patient experiences of initial trauma care** -an interview study at a Swedish level 1 trauma centre
Granström A, Strömmer L, Falk A-C, Schandl, A
International Emergency Nursing, Article in press, Accepted 29 August 2018

CONTENTS

LIST OF ABBREVIATIONS

AIS	Abbreviated Injury Scale
ASA-PS	American Society of Anesthesiologists-Physical Status
ATLS	Advanced Trauma Life Support
CT	Computed Tomography
ED	Emergency Department
EMS	Emergency Medical Services
GCS	Glasgow Coma Scale
ICU	Intensive Care Unit
IQR	Inter Quartile Range
ISS	Injury Severity Score
MOI	Mechanism of Injury
NISS	New Injury Severity Score
RR	Respiratory Rate
SBP	Systolic Blood Pressure
TNCC	Trauma Nursing Core Course
TTA	Trauma Team Activation

1 INTRODUCTION

The idea of this thesis came from my experiences of working with trauma patients in a specialised trauma unit. Initially, the driving force of this research project was to gain knowledge and facts about over and under triage of the trauma patients. Which patients needed treatment at the highest level of care? Did we prioritise correctly? Was this the optimal way to treat all trauma patients? These were some of the questions raised, and in this thesis, I will make an attempt to answer some of them.

The topic is studied from different aspects, an organisational perspective of trauma care and the patient's perspective on the received care. Two different approaches were used, one quantitative study where the scope was to treat patients at the adequate care level and one qualitative study where patients who had been exposed to severe trauma and resuscitation at a level 1 trauma centre were interviewed regarding their experiences. The combination of quantitative and qualitative approaches could create an enhanced understanding of this research field. [1,2] Up to date, patient experiences and satisfaction of received care are rarely reported and there is a need to include patients' perspectives, in trauma care research. [3]

2 BACKGROUND

2.1 TRAUMA

The original meaning of the word "trauma" is from ancient Greek and means wound. Trauma can have different meanings depending on in which context of medicine it is used. A physical trauma is an injury caused by an external force such as motor vehicle crashes, falls, violence, assaults or other physical injuries to the human body. The specialty traumatology is the branch of medicine where surgeons treat patients exposed to severe injury. Severe trauma is experienced in all age groups, the majority however, are young people around the world. It is a global health concern and the major cause of death among people under the age of 45. [4,5] In 2016, 4687 persons died from injuries in Sweden. [6]

During the last decades, trauma organisations has been established worldwide, to prevent individual suffering and to reduce costs associated with motor vehicle crashes, assaults and violence. Trauma care systems in Europe follow the guidelines of American College of Surgeons Committee on trauma. [7] Trauma care can be described as a chain consisting of several links, starting with the injury, going through rehabilitation and ends when the patient is rehabilitated and back home or back to work (Figure 1). In the last decades, trauma care organisations has developed in all links, from prevention, pre-hospital care to trauma centres and rehabilitation. [8] One way of improving the outcome for trauma patients is to treat trauma patients at designated trauma centres. [9,10,11] Also, the reporting to trauma registries, to further develop care and enable research has increased.

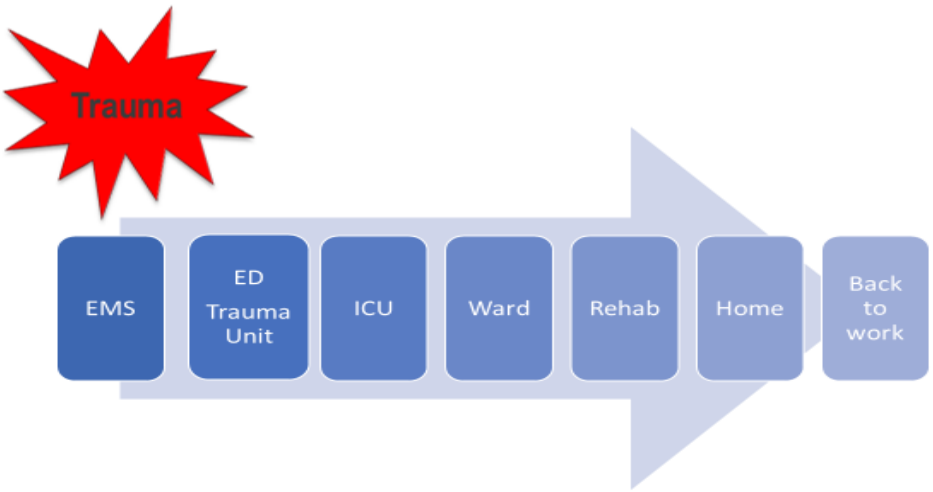


Figure 1*. Illustration of the typical injured patients' optimal journey through the trauma system, for the younger adults, in an optimal setting. Emergency Medical Services (EMS). Emergency Department (ED), Intensive Care Unit (ICU).*

2.2 TRIAGE

The word "triage" derives from the French word "trier" and was used during the Napoleon wars in the 19th century. It means "to sort and select". The term was used to select and give priority of the injured patient. Triage is based on the severity of the injury, the patient´s urgent need and available resources. In a trauma setting, it is the prioritisation of patients' care and is used in pre-hospital- as well as in-hospital settings. [8] In-hospital triage of trauma victims is based on information from the emergency medical services (EMS) and is used for directing patients to an adequate level of care in the hospital. The alarm activating process of the local trauma team, limited or full, is crucial for the following prioritisation and treatment of patients. [7,8]

2.2.1 Over triage and under triage

Monitoring 'over triage' and 'under triage' is often used as an indication of the trauma care quality. Various methods and algorithms on how to calculate over- and under triage are used in research, [7,12-16] and therefore, it can be difficult to compare results from different trauma centres.

Over triage occurs when less severely injured patients are triaged to higher level of care and full trauma team activation. Over triage may imply an overconsumption of human and financial resources. [17] Since full trauma team personnel are called from other urgent activities, other critically-ill patients in need of non-trauma care may be less prioritised. [18]

Under triage occurs when the severity of the injury is underestimated i.e. seriously injured patients who are triaged to a lower level of care and an activation of a limited team. Under triage may increase the risk for disability or death. [19] The effort to keep under triage low often

leads to a higher over triage rate. It is recommended by American College of Surgeons Committee on Trauma (ACS-COT) to aim for a under triage rate of <5% which often leads to an over triage rate of up to 35-50%. [7] High over triage rates is a common problem in trauma centres in Scandinavia. [4,12,13,20,21]

2.3 TRAUMA TEAMS

To avoid high over triage rates, most trauma centres around the world use a two-tiered triage criteria system. [22-27] The aim of such systems is to select trauma patients with affected physiology and specific anatomic injuries to full trauma team activation (TTA+). Patients presenting only with mechanism of injury (MOI)-criteria (e.g. falls, assaults or motor vehicle crashes) should be selected to limited trauma team activation (TTA-). Full trauma team activation for these patients has been shown to have low predictability for severe trauma. [8,20,26,28]

In most trauma centres worldwide and at Karolinska University Hospital, full trauma teams consist of a multi professional group, supervised by a trauma leader, and up to at least 10 health-care professionals present during the first examination at the trauma centre. [7,8,29-32]

The full trauma team assesses the patient in the trauma room which is situated close to computed tomography (CT)-scan and the operating theatre. The multi professional team at a level 1 trauma centre, consists of surgeons, orthopaedic surgeons, anaesthesiologists, radiologists, theatre nurses, nurse anaesthetists, emergency department (ED) nurses, radiology nurses and are called from other tasks and gathered at the trauma room to meet the incoming trauma patient. Neuro surgeons are notified that a trauma patient is incoming. The assessment includes a rapid examination according to the Advanced Trauma Life Support (ATLS) [29] and the Trauma Nursing Core Course (TNCC) concept, in order to find and treat life-threatening conditions immediately. [33]

The limited trauma team consists of a reduced number of professionals, often the surgeon on call and/or an ED-doctor and two ED-nurses, a radiology doctor and a radiology nurse are notified (Figure 2). When the limited team is alerted, the trauma patient is assessed in the ED.

Full trauma team (trauma room)	Limited trauma team (ED)
Trauma Surgeon	ED Physician and/or Surgeon on call
Anaesthesiologist	ED Nurse
Orthopaedic Surgeon	ED Nurse assistant
Theatre Nurse	
Nurse Anaesthetist	
ED Nurse	
Radiologist	
Radiology Nurse	
Theatre Nurse assistant	
ED Nurse assistant	
Neuro Surgeon (for knowledge only)	

Figure 2*. Multi professional groups of full trauma team and limited trauma team at Karolinska University Hospital.*

2.4 TRAUMA SCORING

Scoring trauma severity dates back to the 1970s when the Injury Severity Score (ISS) was developed by Baker et al. [34] It was shown that the correlation between severity of injury and mortality was exponential. In 1990, Champion et al [35] published the Major Trauma Outcome Study (MTOS) where more than 10% of trauma patients with an ISS above 15 had an increased risk of death. Since then, ISS > 15 has been widely used as a threshold for defining major trauma in trauma research.[4]

The Abbreviated Injury Scale (AIS) was developed in 1971 to classify anatomic injuries. Each injury is classified by body region and severity, and obtains a number from 1-6, where 1 is a minor injury and 6 is a lethal injury. [36] The Association for the Advancement of Automotive Medicine (AAAM) monitors the AIS, provides a standardised terminology and updates the AIS. [8]

To calculate ISS, the AIS-scores from the most severe injuries in three of the six different body regions, are squared and added, which gives an ISS score from 0-75, where 75 corresponds to a lethal injury. One AIS score of 6, results in ISS 75, independently of other injuries. The ISS-body regions are; 1) head and neck, 2) face, 3) chest, 4) abdominal and pelvis, 5) extremity and 6) external.

In 1997, the new injury severity score (NISS) was introduced to address some of the issues with ISS, e.g. not taking physiology into account or underestimating severe injuries present in the same body region. NISS-scoring is calculated in the same way as ISS with one difference, the three highest AIS codes can be used even if they are located in the same body region. NISS is supposed to be more accurate for e.g. penetrating injuries and traumatic brain injuries (TBI)[37]. However, in a recent meta-analysis, the ISS and NISS scores were compared and it

was concluded that the two scoring methods had equally good precision in predicting mortality. Further research was recommended to evaluate when to use ISS or NISS. [38]

2.5 TRAUMA REGISTRIES

Many trauma centres around the world report their data to national trauma registers.[39-43] The first trauma registry dates back to 1969, and was initiated in Cook County Hospital, Chicago. [44] The registries are used to develop and evaluate the trauma care and also to facilitate comparisons between trauma centres. [45]

2.6 PATIENT CENTRED CARE AND TRAUMA

Focus on patient satisfaction and experiences is becoming more and more requested in health care. The term "patient centred care" was first introduced by the Picker Institute in 1988. [46] The intention was to alert the need for health care professionals to shift focus from technical skills to patient needs. The Picker institute has through a research project identified eight areas in which patients rate the most important areas concerning their care. It includes; respect for *"patients' values, preferences and expressed needs, coordinated and integrated care, high-quality information and education…"*. Moreover, patients state physical comfort, pain-management and emotional support and also continuity of care even if transitions are required. [46] Studies have shown that including patients in their own care has led to increased survival, improved health-related quality of life, and increased patient satisfaction. Patient centred care implies a shift in traditional roles of patient and health care personnel. [47] However, in a life-threatening situation, as after severe injury, patient preferences are often of subordinated importance.

2.7 RATIONALE

In 2011, criteria for care level and activation of full or limited teams were to find in the local guidelines for trauma at the hospital, but no check-list or protocol were at hand to support triage decisions. No systematically documentation of the criteria was performed. Compliance to documentation of the trauma alert criteria in the ED was poor or even non-existing. It was impossible to find any documentation of on what criteria the trauma team had been activated. Such documentation should be present according to the local guidelines.

Also, there is a paucity of information about how trauma patients experience the care and assessment. It might be assumed that being exposed to an assessment performed by a large number of trauma team members, together with the often-un-familiar setting and high technological equipment can be perceived as frightening. Most previous studies about patient experiences in the acute setting are focusing on either health-care personnel's experiences,[48-51] or trauma patients treated in the ED or pre-hospital care. [47,52-58]

3 AIMS

The overall aim was to investigate patient and organisational perspectives of initial trauma care.

The specific aims were:

- To evaluate if a criteria-directed protocol in the emergency department could improve triage and direct trauma patients to an adequate care level

- To explore trauma patients' experiences of being exposed to initial full trauma team treatment at a level 1 trauma centre.

4 MATERIAL AND METHODS

4.1 STUDY DESIGN

An overview of study design and outcome measures is shown in Table 1

Table 1.

Study	**I**	**II**
Design	Quasi-experiential, implementation	Semi structured face-to-face interviews
Data sources	Trauma Registry Karolinska	Audio-recorded interview text
Population	Data from 1720 +1555 trauma patients	16 trauma patients
Study Period	2011 & 2013	2016-2017
Analysis	Descriptive statistics. Sensitivity and specificity analysis	Qualitative Content Analysis
Outcomes	Over- and under triage rates before and after implementation of a protocol	Patient experiences

Study I was a single-centred study with quasi-experimental design evaluating the effect of a protocol containing pre-established criteria and level of trauma team activation. Triage levels for trauma patients admitted to the hospital were compared between 2011 and 2013. For study II, qualitative individual interviews with trauma patients were held in 2016 and 2017 to explore patients' experiences of initial trauma care.

4.2 SETTING

The Karolinska University Hospital is the primary trauma centre in the Stockholm area, and covers more than 2 million inhabitants. The trauma unit is comparable to a Level 1 trauma centre referring to resources available and number of admitted patients, even if it has not yet applied for the formal verification issued by American College of Surgeons. The hospital admits approximately 1500 trauma patients annually, out of which around 30% are seriously

injured with an ISS >15. Blunt trauma is more common than penetrating trauma, 90 % versus 10%. Approximately 70% of the trauma cohort are men. [59]

4.3 PARTICIPANTS

4.3.1 Study I

All trauma patients admitted to Karolinska University Hospital in 2011 and 2013 and were registered in the Trauma Registry Karolinska were included in the study.

4.3.2 Study II

All adult patients who had been assessed at the trauma unit and triaged to level 1 priority at Karolinska University Hospital Solna were eligible for inclusion. Patients who were comatose or sedated during initial trauma treatment, or non-Swedish speaking, were excluded.

4.4 DATA COLLECTION

4.4.1 Study I

Before the implementation of the protocol, criteria were reported from EMS to the triage nurse in the ED, who decided what care level to alert, with-out any criteria at hand. The protocol was introduced in 2012 as a tool, to support triage decisions by having the criteria present, when receiving the criteria information about the incoming patient from the EMS. In 2013 the protocols were used to determine care level in the ED.

4.4.1.1 Data Sources

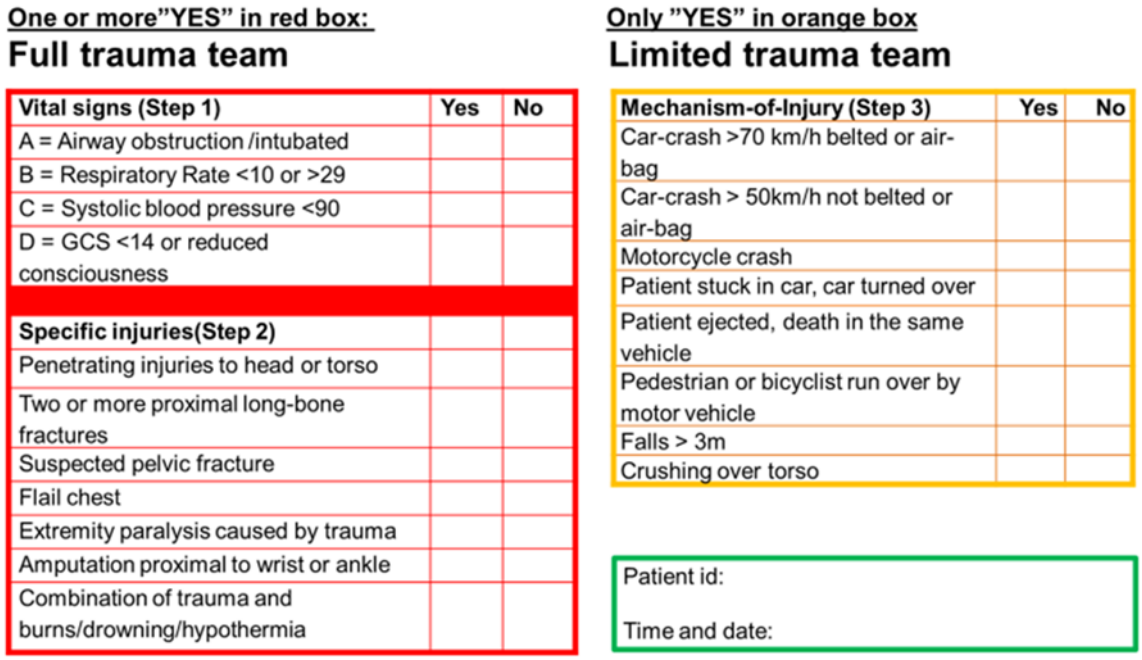
Demographic data and treatment variables were retrieved from the Trauma Registry Karolinska. Since 2005, data from trauma patients have been reported to the Trauma Registry Karolinska. Patients are included if they activated the trauma team or if they retrospectively were found to have injuries corresponding to an ISS-score >9. More than 35 data variables that describe the patient and the organisation, e.g. physiological parameters, co-morbidity, injury coding, highest level of care and outcome, are documented in the registry. [60]

Four registrars work with the registry. All four are nurse anaesthetists with experience from working with trauma patients and have attended the AIS classification course. Internal validation of the registry is performed every year both for background data and for the coding of injuries. Injuries are coded according to AIS 2005 update 2008. [61]

Starting in 2011, patients are also reported to and included in the national trauma register Swedish Trauma Register (SweTrau). [62] In 2017, 38 out of 55 Swedish hospitals that admits injured patients reported to SweTrau.

4.4.1.2 Intervention

The criteria-directed protocol was constructed with criteria according to the local guidelines of trauma (Figure 3). Additional parameters, such as selected trauma level, full or limited team and date of trauma were also included. The protocol was implemented in the ED during 2012. The layout of the protocols was updated according to suggestions from triage responsible staff in the ED in 2012. Several information meetings and lectures were held to inform about the content and the importance of the protocol. The protocols were collected monthly from the ED to control for compliance. The protocols from 2012 were omitted to control for "starting-up problems".



One or more"YES" in red box:

Full trauma team

Vital signs (Step 1)	Yes	No
A = Airway obstruction /intubated		
B = Respiratory Rate <10 or >29		
C = Systolic blood pressure <90		
D = GCS <14 or reduced consciousness		
Specific injuries(Step 2)		
Penetrating injuries to head or torso		
Two or more proximal long-bone fractures		
Suspected pelvic fracture		
Flail chest		
Extremity paralysis caused by trauma		
Amputation proximal to wrist or ankle		
Combination of trauma and burns/drowning/hypothermia		

Only "YES" in orange box

Limited trauma team

Mechanism-of-Injury (Step 3)	Yes	No
Car-crash >70 km/h belted or air-bag		
Car-crash > 50km/h not belted or air-bag		
Motorcycle crash		
Patient stuck in car, car turned over		
Patient ejected, death in the same vehicle		
Pedestrian or bicyclist run over by motor vehicle		
Falls > 3m		
Crushing over torso		

Patient id:

Time and date:

***Figure 3**. Criteria for triage of trauma patients used in study I*

4.4.2 Study II

4.4.2.1 Interviews

A semi-structured interview guide was constructed and used to facilitate and encourage the participants to express their experiences and elicit patients' stories and perspectives of being taking care of in the trauma room. The interview technique was based on laddered and probing questions that would provide a good base for the interviews. The idea was to use elected level of questioning, going from less invasive to more invasive questions. Questions about action were used at the beginning and the end of the interviews, knowledge questions in the middle and questions about feelings, values and beliefs towards the end of the interview.[63] Questions like: "*Can you tell me what you remember from the trauma room"* and *"How was the atmosphere in the room"* were asked.

The interviews took place in a secluded room within 4 days after the injury, so that patients would have a possibility to recall the event. The intention was to create a calm and safe environment for the interviews and establish a professional contact with the interviewees.

An expert in interview technique was consulted to evaluate the interview guide and the first interview. No changes were made in the interview guide after that and the first interview was included in the study. The interviews were audio-taped and transcribed for analysis.

4.5 OUTCOMES

4.5.1 Study I

In study I the outcome was the difference in over and under triage rates before and after the implementation of a protocol with criteria for alerting full trauma team or limited trauma team. Trauma patients with minor injuries according to the Injury Severity Score (ISS<15) who were triaged to full trauma team, were defined as over triage. Under triage was defined as a severely injured patient with ISS >15 who were triaged to a limited trauma team, within the trauma system of the hospital. Patients was categorised into correct-, over- and under triaged groups depending on injury severity and activation of trauma team. Over- and under triage rates were compared between the groups.

4.5.2 Study II

In study II, the outcome was patient experiences of initial trauma care.

4.6 STATISTICS AND DATA ANALYSIS

4.6.1 Study I

Continuous variables were reported as the median and interquartile range (IQR) and categorical variables as numbers (n) and proportions (%). None of the variables were normally distributed so Mann Whitney U-test was used for continuous data and Fisher's exact test were used for categorical values.

Potential over triage and under triage rates before and after the implementation of the protocol were calculated with a model for sensitivity and specificity (sensitivity as: a/ (a+c) and specificity as: d/b+d)), where potential over triage was 1 – specificity and potential under triage was 1 – sensitivity (Table 2). Calculation of over- and under triage rates are referred to as Matrix, Cribari or modified Matrix. [7,12,64,65] Calculations were performed according to the intention to treat principle.

A peer-review consisting of a trauma surgeon, an anaesthesiologist, the trauma registrars, a trauma coordinator and a nurse anaesthetist reviewed the under triaged patients' medical charts regarding criteria, treatments and outcome.

The P-value to assign statistical significance was set at 0.05. GraphPad Prism version 6.0 (GraphPad Software, La Jolla, CA, USA) Microsoft Excel 2011 and 2013 (Microsoft, Redmond, Washington, USA) were used for statistical analysis.

Table 2. Injury severity (ISS) compared with activation of trauma team (TTA), Sensitivity: a/(a+c) and specificity as d/(b+d).

	ISS >15	**ISS <15**
TTA+	a	b
TTA-	c	d

4.6.2 Study II

Descriptive statistics were reported as numbers and proportions for categorical data, median and IQR were reported for continuous data.

The data consisted of transcribed interview texts and were analysed with qualitative content analysis, as described by Elo, Kyngäs et al, using an inductive approach. [66] The analysis started with a preparation phase, when all the audio-taped interviews were listened through and transcribed verbatim. The text was read through, line-by-line, several times by members of the research group. Headings were noted while reading, open coding, and the headings were collected in an Excel-document. Meaning units were identified, shortened, collected and grouped under the headings according to similarities. The condensed meaning units were moved back and forth in the Excel-document to find the most appropriate heading. A general description was formulated (abstraction) and used to generate categories. Content characteristic words were used to describe the meanings and sub-categories, generic categories and a main category emerged.

4.7 ETHICS

4.7.1 Study I

The ethical principles according to Helsinki declarations [67] were respected. Study I contained anonymised data obtained from the local trauma registry, Trauma Register Karolinska. Application to extract data from the registry was sent to the local registry keeper and was granted after approval from the Regional Ethical Review Board in Stockholm, Sweden (Dnr 2010/1065-31-1 and 2012/1965-32).

4.7.2 Study II

In study II, all patients received written and oral information. The participants signed a written consent form prior to the interviews. Patients' autonomy and integrity, "to do good", "not harm", fairness and honesty were carefully considered. There is a risk of violating the patients' autonomy and integrity by asking them to participate in the study, since they are in a vulnerable situation and dependent of their care givers. However, all patients were informed that their participation was; anonymised, voluntary and that they could withdraw from the study at any time. Participants were also informed that the interviewer and the research team were not involved in their care pathway. The scope of the interviews was to improve trauma care by collecting patients' experiences, to do good, improve knowledge and enhance patient participation. The patients were informed that there was no personal advantage for them to participate, but that the result might be of importance for future patients. If the interviews raised questions or worries the participants could contact a psychologist at the trauma ward. The study was approved by the Regional Ethical Review Board in Stockholm, Sweden (Dnr 2015/2269-31)

5 RESULTS

5.1 STUDY I

Among the 1720 trauma patients who were recruited in 2011, 312 were excluded since they had not been exposed to in-hospital triage, those patients were either transferred from other hospitals after agreements with the trauma-leader or transported directly to neuro intensive care or neuro surgery by the EMS. In the 2013 group, 89 patients were excluded due to the same reasons.

Approximately 10% of the patients were suffering from penetrating injuries and 90% were exposed to blunt trauma. Demographic data and trauma related variables were similar between the two groups except for co-morbidity, shown as American Society of Anaesthesiologists Physical Status (ASA-PS), and Glasgow Coma Scale (GCS). Patients in the before-protocol group had statistically significantly less co-morbidity (ASA-PS) and lower GCS scores compared with the after-protocol group. Patient characteristics are shown in Table 3.

Table 3. Characteristics of the patients included in Study I

Category	**Before protocol (N=1408)**	**After protocol (N= 1466)**	**p-value**
Men [n (%)]	98 (70)	1006 (69)	NS
Age (years) [median (IQR)]	39 (25-55)	40 (26-57)	NS
ASA-PS 1-2 [n (%)]	1303 (93)	1296 (88)	<0.05
ISS [median (IQR)]	5 (1-12)	5 (1-10)	NS
SBP (mmHg) [median (IQR)]	140 (126-158)	140 (125-159)	NS
RR [median (IQR)]	18 (14-20)	17 (14-20)	NS
GCS [median (IQR)]	15 (14-15)	15 (15-15)	<0.05
Blunt trauma [n (%)]	1288 (91)	1324 (90)	NS
Mortality [n (%)]	72 (5)	54 (4)	NS

5.1.1.1 The criteria-directed protocol

In 2013, 84% of patients were triaged according to the protocol and 72% of the protocols were complete. Missing data in the protocols were mainly what criteria that activated the trauma team and/or level of care. The date of the injury and the identification of the patients were also missing in many of the protocols.

5.1.1.2 Over and under triage rates

After implementing the protocol, the proportion of over triaged patients was reduced from 78% to 58% and the proportion of under triaged patients increased from 7% to 11 %. Sensitivity and specificity were 93% and 26% before protocol and 90% and 48% after the protocol. Calculations were performed by intention to treat and the potential over triage rate was reduced from 74% to 52% and potential under triage rate was increased from 7% to 10% (Table 4).

Table 4. Comparison of injury severity with trauma team activation

	Before protocol (2011)			**After protocol (2013)**		
	ISS>15	**ISS<15**	**Total**	**ISS>15**	**ISS<15**	**Total**
TTA+	230 (a)	864 (b)	1094	225 (a)	631 (b)	856
TTA-	17 (c)	297 (d)	314	24 (c)	586 (d)	610
Total	247	1161	1408	249	1217	1466
Sensitivity(%)	93			90		
Specificity(%)	26			48		

As a consequence of the lowered over triage and increased correct triage, fewer trauma patients were treated in the trauma room by a full trauma team (TTA+) and more trauma patients were treated at the emergency department by a limited trauma team (TTA-) (Figure 4).

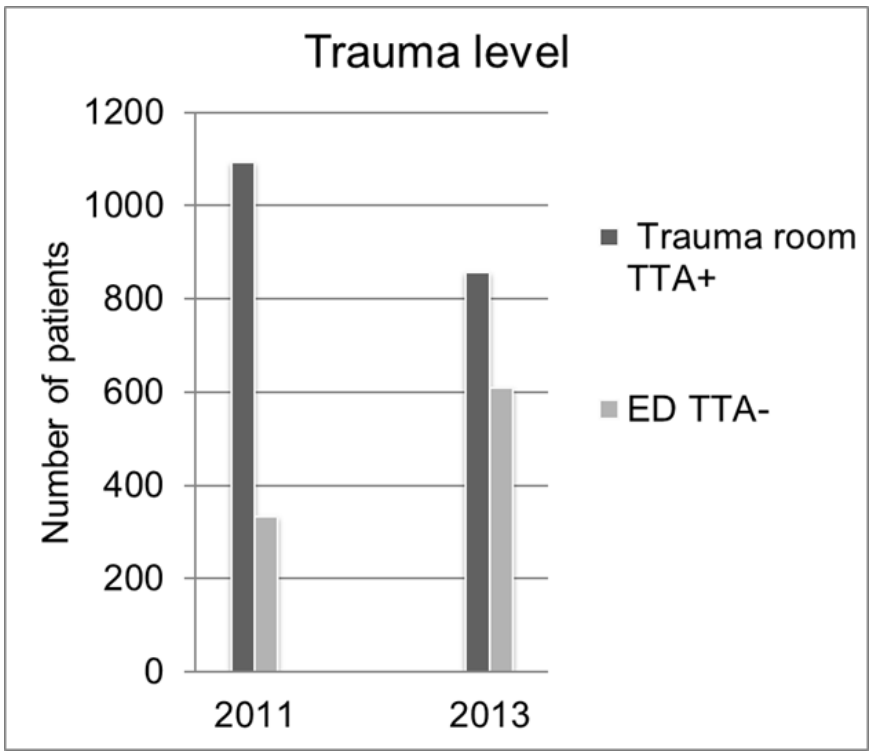


Figure 4. *A bar chart shows the change in location for trauma patients and activation of trauma teams before and after the implementation of the protocol.*

An illustration of over and under triage rates are shown in figure 5. (Figure 5).

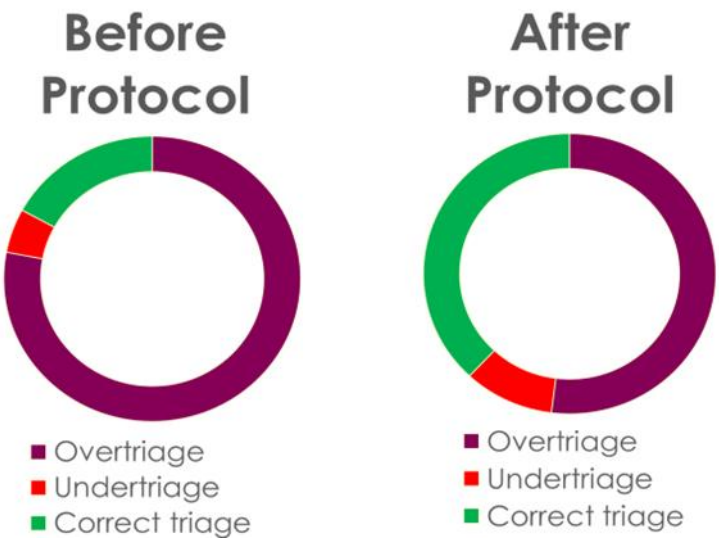


Figure 5. *Rates of over- and under triage before and after implementation of the protocol containing criteria for activation of full or limited trauma team*

The medical records of patients who were found to be under triaged were retrospectively subject to peer- review and no adverse outcome or preventable deaths among these patients were found.

5.2 STUDY II

Sixteen trauma patients who were treated after injury and assessment in a specialised trauma centre by a full trauma team were interviewed. Patient characteristics are shown in table 4.

Table 4.

Characteristic	Participants (N=16)
Men	12 (75%)
Age in years, median (IQR)	32 (26-50)
ASA-PS, 1-2	14 (90%)
ISS, median (IQR)	10 (5-14)
Injury type[1]	
Head/Neck	8 (50%)
Facial	1 (8%)
Chest	8 (50%)
Abdominal	4 (25%)
Pelvic	2 (13%)
Extremity	9 (57%)
Superficial	(8%)
Dominating type of injury	
Blunt trauma	12 (75%)
Penetrating trauma	4 (25%)
Mechanism of injury	
Traffic	8 (50%)
Fall	4 (25%)
Assault	4 (25)

Numbers and percentage are presented for categories and median and Interquartile Range (IQR) for continuous variables, [1] more than one type of injury for some patients. ASA-PS, American Society of Anaesthesiologists Physical Status (1-6) and ISS, Injury Severity Scale (1-75)

After analysing the interview text one main category emerged: "Feeling safe in a frightening situation". Patients stated that they felt safe with expressions like: "*Everything that they did, seemed to go like clockwork. Everyone knew exactly what to do"* and *"There was a good team spirit…everyone acted professionally"*. Also, three generic categories emerged: "emotional response", "physical discomfort" and "feeling prioritised or being ignored". Other than feeling safe patients also reported fear and worries; *"I screamed, I am going to die"*. In the second generic category patients reported physical discomfort such as: *"I was tied up...I*

could hardly move". In the third generic category patients expressed feelings of being ignored: *"…it was as if I wasn't there"* and: *"For them it was a normal day at work, but I thought I was going to die, that it was my last night of life"*. Yet, patients also reported that they appreciated caring actions: *"they understood…they tried to ease my pain"* (Figure 6).

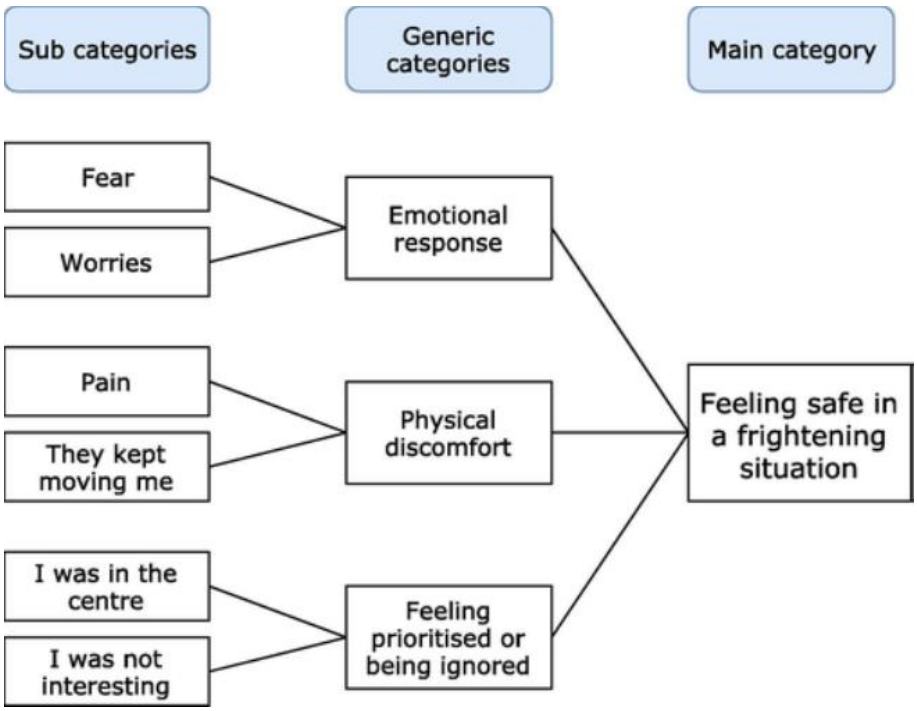


Figure 6. *Flowchart of categories in study II*

6 DISCUSSION

6.1 METHOD DISCUSSION

This thesis consists of a combination of two different approaches; a quantitative implementation study and a qualitative interview study, linked together by the interest to improve organisation and patient care in the trauma system. Its focus was on triaging the right patient, to the right level of care at the right time and how the patients experience their care.

6.1.1 Study I

6.1.1.1 Study design

Study I was a quasi-experimental study. In trauma research, it is difficult to perform randomized controlled trials since it is often unpractical and even unethical to ask for and obtain written informed consent in an acute situation.

6.1.1.2 Selection bias

Selection bias is less commonly observed in cohort studies with high participation rates. Data was extracted from Trauma Registry Karolinska which has a robust inclusion methodology and active data verification and strategies to minimise missing data. The registry is internally validated by the registrars at the centre on an annual basis with a validation key. However, the registry has not been externally validated and therefore results may not be extrapolated to the entire Sweden.

6.1.1.3 Measurement errors

Under triage was calculated as the proportion of patients with an ISS-score >15 (severely injured) who did not activate full trauma team compared with all patients with ISS >15 and over triage was calculated as the proportion of all not severely injured (ISS<15) to all patients with an ISS-score of <15.

ISS was initially developed to predict mortality depending on the severity of the injuries and has been criticised for not considering; co-morbidity, physiology and for scoring head injuries equal to extremity injuries. The ISS has also been criticised for not considering severe injuries if they are in the same body region, as often is the case in penetrating injuries. Despite this, it is still widely used for trauma scoring in trauma registries and in trauma research.

Peer-reviews' has been criticised for being subjective and create difficulties when comparing results with other centres.

6.1.1.4 Confounders

Confounders are described in epidemiological research as factors that relate to both exposure and outcome. Confounding was potentially relevant in this study since patients were not

randomised into groups. Data from the comparison group (2011) were collected one year before data from the intervention group (2013) This was chosen deliberately so that the protocol could be implemented during 2012 and be familiar to the ED-staff in 2013. Other confounders could be changes in staff or trauma treatment routines There is a risk that other factors not known to us could have influenced the study population.

6.1.1.5 Generalisability

The study was performed in a single centre in Sweden, which can limit the possibilities to generalise the results to other hospitals and countries. However, the study populations were large and may be considered to be representative for other trauma populations in high-income countries. [10,68] In Sweden, health care is available to all citizens since it is tax-funded, which is not the case in other countries, which is an aspect to consider when extrapolating for other countries

6.1.2 Study II

6.1.2.1 Selection bias

Selection bias means if there is an error when identifying participants in the study. In qualitative research the purpose of the study population is not to include as many patients as possible, but to collect as much information as possible about the subject of interest.

The intention was to collect all different experiences from interviewees with a wide range of different experiences. Participants who could answer to the research question and the aim of the study and had properties similar to all trauma patients in an annually basis at Karolinska University Hospital, were included.

Patients were included until no new information was generated. However, there is always a possibility that the inclusion of more participants could have gathered more information from patients with perhaps other experiences. The patients in the study who were willing to participate, could possibly have been more extrovert than patients who declined participation and resulted in a skewed study group. Patients who were unconscious, sedated, under influence of alcohol or drugs during the initial assessment in the trauma room, or if they were non- Swedish speaking, were not asked to participate. It is possible that those patients, could have reported other experiences from the trauma room than the experiences that the patients included in the study reported.

6.1.2.2 Interviews

To describe a patient's experiences the best way is to ask him or her! However, the research interview is quite different from everyday interviews in patient care. For example, the purpose and outcome are determined by the setting, the reasons for the interview and the roles of the interviewer and the interviewee. [69] Interviews, open or semi structured are often used in care sciences. One advantage of using face-to-face semi-structured interviews, as in this study, is the possibility to gain immediate response and probe into some specific aspect

in the interviewees' response. [70] Interviewing is difficult and requires experience and skills. In this study, the interviews were not performed by a professional experienced interviewer and therefore the planning had to be thorough. A semi-structured interview guide was used, and a pre-defined interview technique was established. Also, the interviewer had previous knowledge and understanding of the context of trauma care and was trained in interview technique.

6.1.2.3 Content analysis

Inductive content analysis was used to analyse the data. [66] To explore patients' experiences, an appropriate method for analysing the data was found to be content analysis. Qualitative research answers to the question how. It can explain what is important for the patient and is needed to be included in trauma research [3]. Content analysis is an established method that have been used in social sciences, nursing and journalism for decades. [71,72] When performing the analysis, it was an advantage to have performed the interviews within the research group, since it created a deeper understanding of the data.

6.1.2.4 Trustworthiness

In qualitative research trustworthiness and how it should be established is an important discussion point. Elo et al.[73] suggests using a check-list to improve trustworthiness of content analysis studies. We have performed a thorough preparation of the study, described gathering of the data and sampling of the participants in reporting of the results to enhance trusthworthiness.

The authors consisted of one nurse anaesthetist, one surgeon, and two critical care nurses, with different research credentials and could contribute to the analysis with aspects from different perspectives. However, we cannot exclude that including other competencies such as a psychologist or a medical social worker could have resulted in a slightly different result.

As clear and distinct description as possible of the setting and the patients was provided so that the readers could have a possibility to decide on the transferability of the results. [73]

6.1.2.5 Intern validity

To certify that the study investigated what it was supposed to, describing patients experiences from the trauma room, we used the interview technique suggested by Price [74]. This method suggests that the interviewer should repeat what the interviewee had said, to confirm that the statement was correctly interpreted e.g. by asking questions as: *"did I understand you correct when…"* or: *"is this what you meant saying that…?"*.[74]

6.2 GENERAL DISCUSSION

Many patients were over triaged. Many patients who were treated at the highest level of care found the situation frightening. These two inferences from the studies, could possibly be an incitement to lower over triage, confident that it will lower costs for health care, increase

patient satisfaction and still be safe. Both studies are published independently but connected by being from similar study population. Study II followed up the results from study I, by taking the issue of over triage further, to a patient centred perspective.

6.2.1 Study I

6.2.1.1 Results

In this study, our findings demonstrate that in-hospital triage can be more accurate after the implementation of a protocol including triage criteria. Positive effects on mortality and triage rates after implementation of triage protocols or revision of existing criteria has also been demonstrated in other studies. [14,24,75-77] Shawhan et al.[16] showed in a study similar to ours, that over triage can be reduced and under triage kept at the same safe level after introducing a simplified triage system. However, there are other studies that have found that there was no change in over- and undertriage rates after criteria revisions. [78]

6.2.1.2 Triage

Triage systems varies in different areas globally. The different triage systems depend on available resources and different trauma panorama. Most triage systems in the western world are based on the ACSCOT:s recommendations [7]. Affected physiology and/or specific anatomic injuries after trauma is often an indication that a full trauma team needs to be activated. Mechanism of injury as only criteria for activation of trauma team, is on the other hand less secure on what care level to alert. Recent trauma research has shown that only mechanism of injury and no deterioration in physiology or any of the specific anatomic injuries often leads to over triage and therefore should activate a limited trauma team [77,78]. In a Norwegian study different rates of over- and under triage are shown to vary depending on who performs the triage. [20]

In this study, as in most trauma research, ISS>15 is used as a cut-off point and definition of major trauma. In concordance with other studies we believe that level of TTA and triage criteria do not match and that evaluation e.g. peer review should complete evaluation of under triaged patients. [79] Efforts have been made to evaluate compliance of criteria with over and under triage, and also to see if criteria are accurate to identify patients in need of full trauma team activation. [64] We agree with Lossius et al [13] that consensus on uniform definitions in trauma research should be established to facilitate comparability in trauma research. In Sweden, consensus-based new national criteria for trauma team activation (TTA) was developed in 2016, by an expert panel with the support of a Swedish public insurance company (LÖF). The new national criteria were implemented in Sweden in 2016. Evaluations of the new criteria's possibility to better predict correct care level will be interesting to follow.

6.2.2 Study II

6.2.2.1 Results

Both positive and negative experiences were expressed by the trauma patients. They felt safe but found the situation frightening. They trusted the organisation and experienced it to be mostly well-organised and efficient, mainly because of what they considered to be a well-functioning system, but also due to caring actions from doctors and nurses. This has been confirmed by other studies in similar settings [31,54,57,58,80-82] and is re-assuring. What is alarming is that patients experienced fear, pain, lack of information and some patients felt excluded from what was going on. This is also described in other studies concluding that communication, information and focus on the patient must be improved, in order to enhance patient satisfaction. The patients wanted to be involved in their care pathway. [31,54,57]

We find it of outmost importance to communicate the findings to doctors and nurses who treat trauma patients, in order to strengthen patient-centred care and include the patients in their care to a greater extent than what is shown in study II. To keep focus on the patient during the whole period in the trauma room is important to improve patient satisfaction and avoid uncertainties among patients. It seems as if health care personnel in acute settings, such as the ED and trauma units, tend to lose interest in the patient when the patients' injuries are not life-threatening. [31,57] The trauma team consists of personnel trained in ATLS and TNCC where the focus should be on finding and treating life-threatening injuries quickly. This may not be clear to the patients, who in some cases believed they were going to die. However, the nurses and the doctors had excluded any severe injuries and seemed to have lost interest in the patient and had their focus on something else. The patients in our study reported that it felt awkward when nurses and doctors were laughing together and talking about private activities outside the hospital. It was also described by patients in the present study that "everybody just left". Situations similar to our findings are described by Wiman et al. [58] in what they call "the uncommitted mode". They also explained this behavior with that the trauma team was focusing on and trained to assess and treat life-threatening injuries and patients who were not seriously injured did not understand this and were not given psychosocial attention.

7 CONCLUSIONS

7.1 STUDY I

Implementing a criteria directed protocol in the ED, containing physical signs, specific anatomic injuries and mechanism of injury-criteria, aiming at deciding on what care level to alert, lowered over triage from 74% to 52% and improved correct triage without putting under triaged patients at risk. However, further improvements concerning compliance to and documentation of criteria are needed.

7.2 STUDY II

Patients who were exposed to initial trauma treatment experienced that they were feeling secure but were scared. Emotional response, such as being scared or worried, physical discomfort, and being prioritised or ignored by the members of the trauma team were reported by the participants. Having patients' perspectives on care and treatment in the trauma room after severe trauma is important to develop and improve trauma care. To keep the patient´s physical and emotional wellbeing in focus and maintain an informative dialogue during the whole process in the trauma room, can result in improved patient satisfaction

8 FUTURE PERSPECTIVES AND CLINICAL IMPLICATIONS

Observation studies on trauma resuscitation in the trauma room, to shed light on how the trauma team communicate and collaborate and to give feed-back to the trauma teams, has already been initiated by health care personnel at the hospital and will be interesting to follow.

A potential intervention for the future would be the introduction of a health-care professional in the trauma team, whose task would be to stay close to the patient during the whole assessment and also to be a contact-person through the whole trauma care-chain.

The next step for clinical investigators may be to establish a harmonisation of criteria between those used by EMS in pre-hospital care and criteria used by the ED-staff in-hospital, for activation of trauma teams. On-line reporting of criteria from EMS to ED, that automatically suggest care level in the hospital, could facilitate documentation of trauma alert criteria in the ED, facilitate decisions on what care level to alert and also enable research by collecting these data. Applications for cell phones to use in the EMS is a possibility for the future.

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